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(54) Setting up intelligent network calls to a mobile subscriber

(57) An intelligent network (IN) call is set up from from a fixed network PSTN to a mobile network subscriber 12 served via a mobile switching centre MSC. The mobile network GSM incorporates a home location register HLR for storing information including location information relating to mobile subscribers 12. The call set up procedure for the IN call comprises an origination call model and a termination call model associated respectively with an originating terminal and a terminating terminal. The termination call model associated with intelligent network calls to mobile subscribers is shared between the home location register HLR and the mobile switching centre MSC whereby to facilitate participation of both the home location register and the mobile switching centre in the call termination procedure.

Fig.1.

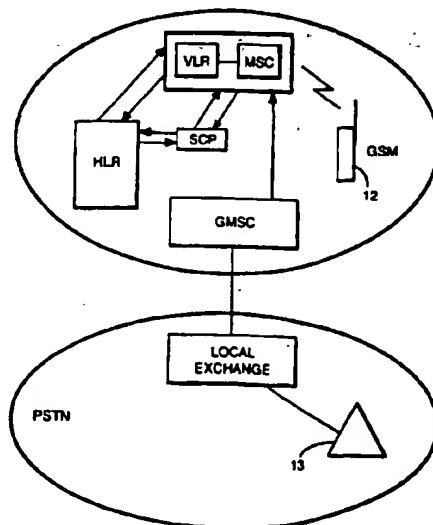
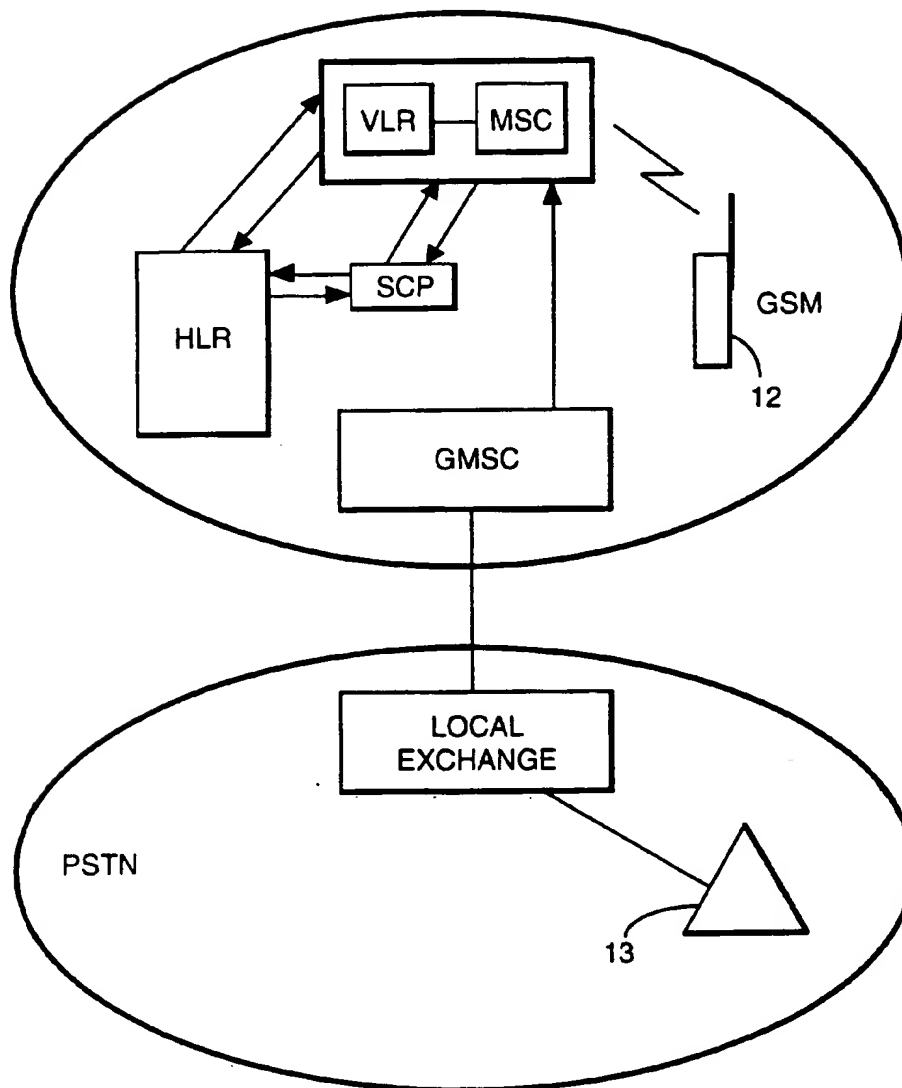


Fig.1.



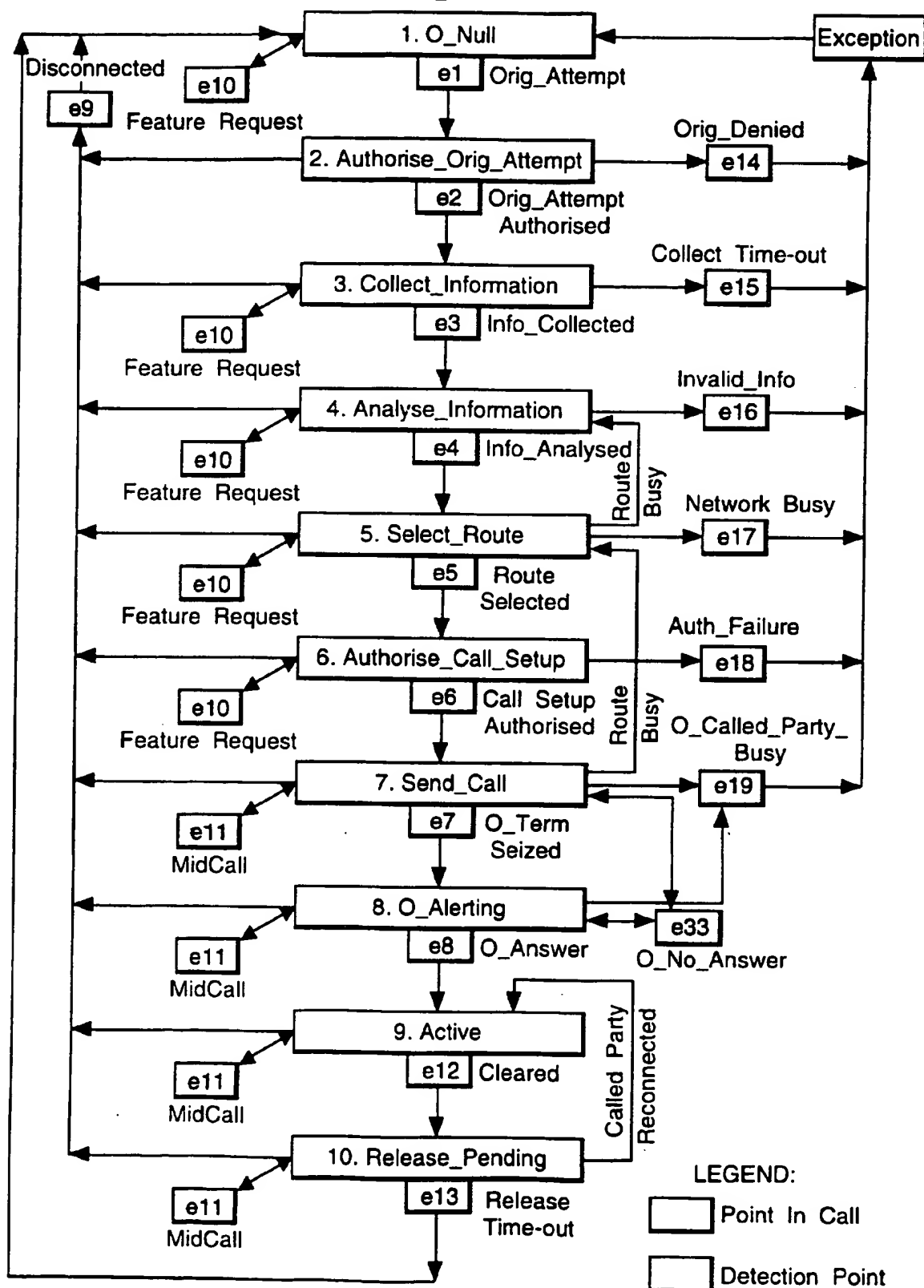


Fig.3.

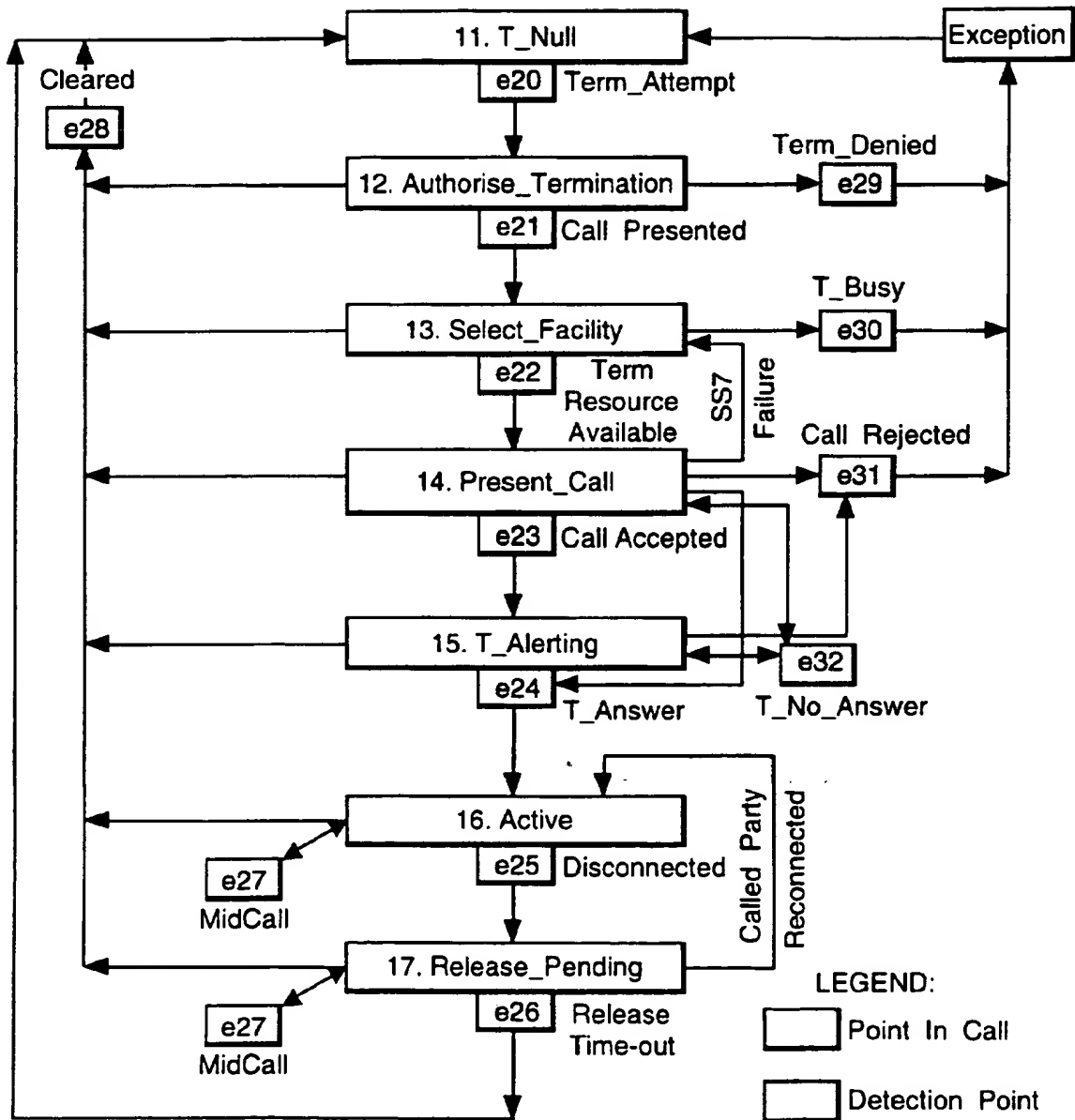


Fig.4.

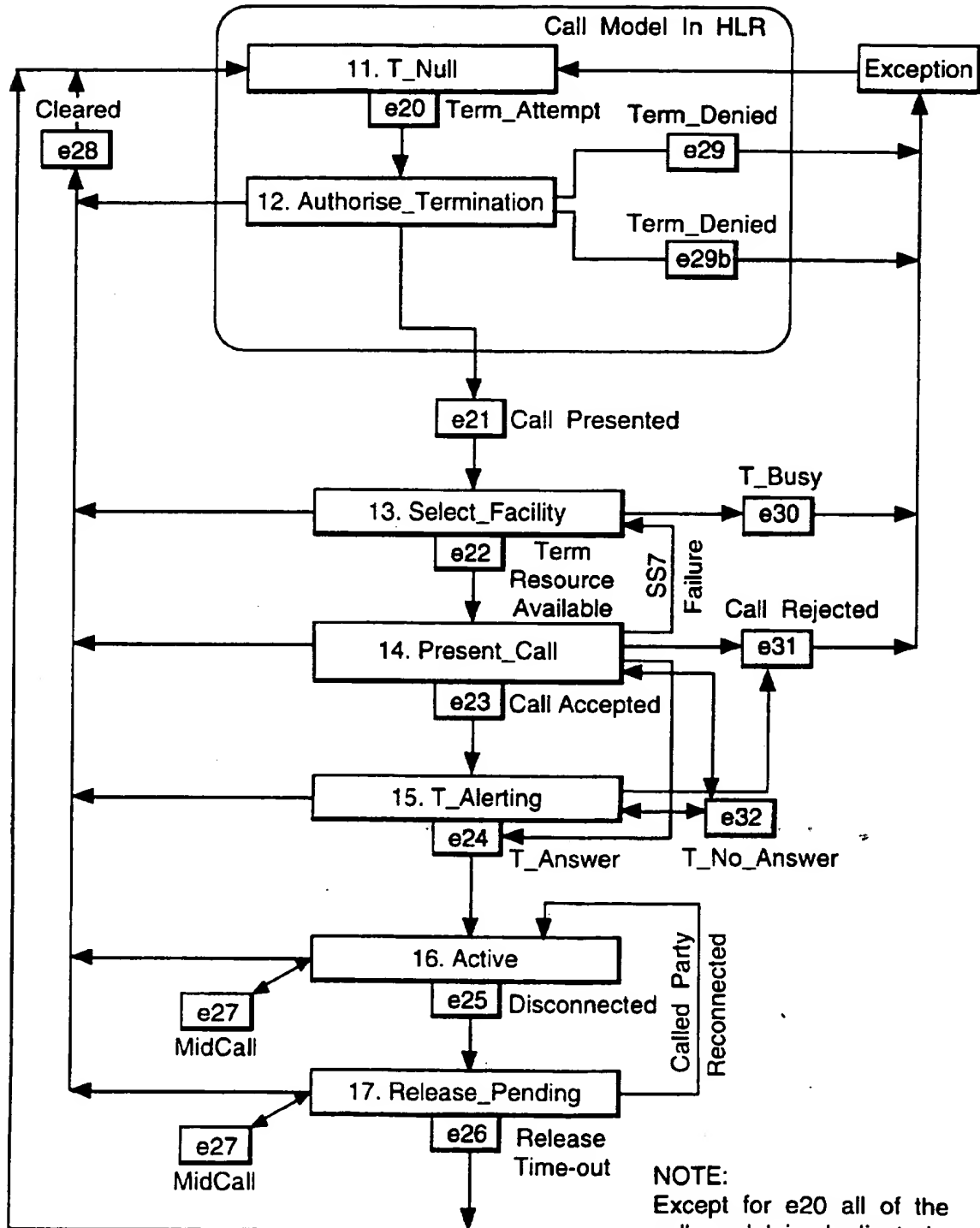


Fig.5.

<u>AIN 0.X PICs</u>	<u>CS-1 PICs</u>
1. O_Null	1. Null & Authorise_Origination_Attempt
2. Authorise_Orig_Attempt	
3. Collect_Information	2. Collect_Information
4. Analyse_Information	3. Analyse_Information
5. Select_Route	4. Routing & Alerting
6. Authorise_Call_Setup	
7. Send_Call	
8. O_Alerting	
9. Active	5. O_Active
10. Release_Pending	

Fig.6.

<u>AIN 0.X PICs</u>	<u>CS-1 PICs</u>
11. T_Null	7. T_Null & Authorise_Termination_Attempt
12. Authorise_Termination	
13. Select_Facility	8. Select_Facility & Present_Call
14. Present_Call	
15. T_Alerting	9. T_Alerting
16. Active	10. Active
17. Release_Pending	

COMMUNICATIONS SYSTEM

This invention relates to mobile communications systems and in particular to an arrangement and method for the provision of intelligent network services to mobile system subscribers.

- 5 A number of mobile communications systems are currently being introduced to provide voice communication to mobile subscriber terminals. In such systems, calls may be set up either between mobile subscribers or between a mobile subscriber and a fixed public network (PSTN) subscriber. A typical mobile system is the GSM system. This
- 10 system provides an interface between mobile subscribers and the public (PSTN) network via a number of mobile switching centres (MSC), each of which serves mobile terminals currently located in cells comprising its service area. Information on the current location of subscribers involved in calls is determined from data stored in a home location register (HLR)
- 15 and one or more visitors location registers (VLR) associated with the system. Setup of calls from and to the mobile terminals involves messaging protocols between the HLR, the VLRs and the MSC. These protocols are defined in a standard associated with the system and all equipment supplied for use in the system is required to conform to this
- 20 standard.

- While these mobile systems currently provide what is effectively a POTS service to their subscribers, there is an urgent need to introduce services, such as call forwarding, call barring, that are provided to fixed
- 25 networks or PSTN customers. These services are provided via an intelligent network (IN) which forms an additional layer of the fixed network. The provision of these IN services to mobile systems has

introduced the problem of establishing protocols that are compatible with current mobile communications standard procedures to ensure that calls incorporating IN services are correctly and efficiently routed to mobile system users. One approach to this problem is described in
5 specification No. WO 93/18606 which describes a system in which an intelligent network wireline system connects to and controls processing of calls to a mobile system handset. However, this arrangement envisages provision of a home location register in the intelligent network. This requires modification of the intelligent network which can reduce
10 that networks capability of operating with a variety of proprietary systems.

It is an object of the invention to provide an improved arrangement and method for supplying intelligent network services to mobile network
15 subscribers.

According to the invention there is provided an arrangement for setting up an intelligent network call from an intelligent network to a mobile network subscriber served via a mobile switching centre, the mobile
20 network incorporating a home location register for storing information including location information relating to mobile subscribers, wherein the call set up procedure comprises an origination call model and a termination call model associated respectively with an originating terminal and a terminating terminal wherein the termination call model
25 has initial stages defining routing information requests and authorisation of termination, wherein said initial stages are provided both in the home location register and in the mobile switching centre, and wherein the termination call model associated with intelligent network calls to mobile subscribers is shared between the home location register and the mobile
30 switching centre whereby to facilitate participation of both the home location register and the mobile switching centre in the call termination procedure.

According to another aspect of the invention there is provided a method
35 of setting up an intelligent network call from a fixed network to a mobile

subscriber served via a mobile switching centre in a mobile network incorporating a home location register for storing information including location information relating to mobile subscribers, the method including defining respective origination and termination intelligent network call models, providing the termination call model in the mobile switching centre, and further providing at least part of the termination call model in the home location register whereby call termination to a mobile terminal is shared between the home location register and the mobile switching centre.

10

The technique provides integration of the special service point (SSP) functions into the mobile network. This creates a node which combines MSC, VLR and SSP functionality.

15

Advantageously, the mobile network incorporates means for providing a mapping between its own call model and other proprietary call models that may be employed by various intelligent network systems.

20 An embodiment of the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is a general schematic diagram illustrating an arrangement for providing intelligent networks (IN) services to mobile network subscribers;

25

Figure 2 illustrates an intelligent network (IN) origination call model employed in the arrangement of Figure 1;

30 Figure 3 illustrates an IN termination call model employed in the fixed network of the arrangement of Figure 1;

Figure 4 illustrates the IN terminal call model of figure 3 adapted for use in the mobile network of Figure 1; and

Figures 5 and 6 illustrate a mapping between two IN call models for origination and termination respectively.

5 Referring to Figure 1, calls incorporating special IN services provided via a fixed or PSTN network may be set up between a mobile network terminal 12 and a fixed network terminal 13 or between two mobile terminals. The terminal making the call is referred to as the call originator and the terminal receiving the call is referred to as the call terminator.

10

In the arrangement of figure 1, each MSC is provided with an associated visitors location register (VLR) containing information on mobile terminals currently in the service area of the MSC. The combined functionality of the MSC and the VLR provides a special service point (SSP) for these mobile terminals.

15

The mobile system is provided with origination and termination call models so that the mobile terminals served by the system can both originate and receive calls incorporating IN services.

20

The IN origination call model employed in this embodiment is illustrated in Figure 2. The successive stages of the call model are referred to as points in call (PIC) and each is associated with one or more detection points. This call model is referred to as the AIN 0.x call model. The mobile MSC origination activity corresponding to the stages of this call model is detailed below.

25

A Setup message is received by the ISSP.

30

A Send Info For Outgoing Call message comprises two messages: ✓

PIC #1 - O-Null

- 1) Provide Subscriber Info-- for getting subscriber (SS+IN) ✓ information. This message is sent by the MSC to the VLR.
- 35 2) Process Orig SS -- to tell the VLR to process originating SS.

e1 - Orig_Attempt is used to indicate that the subscriber profile has been provided by the VLR.

PIC #2 - Authorize-Origin-Attempt

The MSC sends a Process Orig SS message to the VLR to stimulate
5 originating SS processing.

The VLR, depending on the subscriber profile, may perform the following origination SS:

Class of Service (COS), Call Barring, Operator Determined Barring
10 (ODB), Local Calls Only (LCO).

After performing originating services, the VLR may respond to the Process Orig SS message with either of the following messages: (1) Complete Call or (2) Error

15 **e14** - Orig_Denied DP is used for Error case.

e2 - Orig_Attempt_Authorized is used for the Complete Call case. Speech path is established.

e9 - Disconnected is used if the originator releases the call at this point.

20

PIC #3 - Collect-Information

Setup message processing is continued in the MSC.

e3 -Info_Collected is used if the Setup message is processed successfully.

25 **e15** - Collect_Timeout is used for missing or "badly formed" digits.

e9 - Disconnected is used if the originator releases the call at this point.

PIC #4 - Analyse-Information

30 This continues setup message processing

Translations (Source Directed Routing) occurs at this stage. Translations may result either in a Send Routing Information (SRI) or a regular route list for PSTN type terminations.

35

The query to the HLR and the response from the HLR for the SRI message is handled.

As a response to SRI, the HLR may return one of the following:

- a SRI ack message with a MSRN or
- 5 - a Connect_To_Following_Addr message for Call Forwarding, Uncond. and Not Reg., or
- a Call_Barred error message for (Operator Determined) Call Barring.

10 A SRI ack will cause translations to be invoked again (MSRN xlation occurs in this PIC).

A Connect_To_Following_Addr message will result in the creation of a virtual call (model) for the called party.

A Call_Barred error message will result in a call later takedown.

15 **e4 -** Info Analysed is used to enter Send Routing Info (SRI) operation for mobile terminations. For PSTN terminations e4 will be used to indicate the successful termination of translations.

e9 - Disconnected is used if the originator releases the call at this PIC.

e16 - Invalid Info is used to indicate errors in translations.

20 **PIC #5 - Select-Route**

e5 - Route Selected is used if the HLR is reachable for an SRI.

e9 - Disconnected is used if the originator releases the call at this point.

e17 - Network Busy is used to indicate any signalling failures for SRI operation.

25 **PIC #6 - Authorize-Call-Setup**

e6 - Call_Setup_Authorized is used to indicate that call termination attempt is not restricted.

e9 - Disconnected will be used if the originator releases the call at this PIC.

30 **e18 -** Auth_Failure is used to indicate incoming call rejection by the terminator (See SRI).

PIC #7 - Send-Call

This point in call causes a Terminating Call Model to be invoked.

An Initial Address Message (IAM) is sent to the terminator.

Call Proceeding message is sent to the mobile originator.

- 5 **E7** - O_Term_Seized is used to indicate that the terminator has accepted the call.

e9 - Disconnected is used if the originator releases the call at this PIC.

- 10 **e19** - O_Called_Party_Busy is used to indicate that the terminator is busy.

e33 - O_No_Answer is used that the SSP timer expired indicating that the terminator has not yet answered.

PIC #8 - O-Alerting

- 15 Terminator sent Progress or Alerting messages are received in this point in call. For cases of incomplete calls, such things as "user busy", "no answer", "call rejected" may also occur.

The mobile originator is given Progress/Alerting/Connect/Connect Ack messages.

- 20 **e33** - O_No_Answer is used that the SSP timer expired indicating that the terminator has not yet answered.

PIC #9 - O-Active

- 25 At this point in call there is a connection established between the originator and the terminator.

Supervision is being provided.

e12 - Cleared is used if the terminator releases the call

PIC #10 - Release-Pending

- 30 The call take-down sequence occurs at this point in call. For mobile originators the call takedown may involve Disconnect, Release, and Release Complete messages.

e12 - Cleared is used if the terminator releases the call.

In the arrangement of Figure 1, a call incorporating IN services to a mobile terminal 12 is switched from the fixed or PSTN network to a gateway mobile switching centre 14 (GMSC) in the mobile network. Within the mobile network, the first task is to locate the mobile terminal so that routing of the call to that mobile terminal can then be determined. Information relating to all system terminals is stored in a central database commonly referred to as a home location register (HLR) 15 having IN functionality. The GMSC sends a location request to the HLR which accesses the subscriber information and returns the network address of the mobile switching centre (MSC) 16 in whose service area the mobile terminal 12 is currently located. The call is then routed to this MSC. Information is transferred from the HLR to the VLR when a MS first arrives in the MSC. The MSC and the VLR together perform the function of an ISSP. A service control point (SCP) may be provided either in the mobile network as shown or in the fixed network.

In the above procedure, both the HLR and the MSC are involved in the call termination process. In our arrangement this involvement is facilitated by splitting the IN, terminating call model between the HLR and the MSC. This is illustrated in the flow charts of Figures 3 and 4.

Referring to Figure 4, the first two stages of the IN call (PICs 11 and 12) model are contained both in the HLR and in the MSC. In the first stage the HLR receives a message asking for routing information which message triggers a call termination attempts. The formal sequence of events associated with this stage is listed below:

PIC #11 - T-Null

Send Routing Information (SRI) message is received by the HLR with IN functionality.

e20 - Term_Attempt DP is triggered at the reception of the SRI.

In the next stage listed in detail below, the call termination may be authorised:

PIC #12 - Authorize-Termination

The HLR, depending on the subscriber profile, may perform the following termination SS: Call Barring, Operator Determined Barring (ODB), Call Forwarding Unconditional (CFU), Call Forwarding Not Registered (CFNreg), Alternate Line Service (ALS), etc. The HLR may also want to perform roamer service screening.

The HLR sends a Provide Roaming Number (PRN) to the terminating VLR. For IN enhanced HLRs, this PRN will optionally contain IN trigger-subscription information.

e21 - Call_Presented indicates that the call is to be completed (i.e. no barring).

e28 - Cleared indicates that the originator has disconnected.

e29 - Term_Denied indicates that the call is barred.

e29b - Term_Denied indicates that CF_not_registered has occurred.

In some applications the HLR may also perform roamer service screening to take account of the service profile to which a visiting mobile terminal is entitled or is capable of receiving when located in the service area of the mobile switching centre.

Placing the above two points of the IN terminating call model on the HLR provides the HLR with a functionality such that it appears as a service switching point (SSP) to the fixed network service control point (SCP) although the HLR cannot of course provide all the SSP functions that the SCP might request. To address this possibility, either the HLR is assigned to forward such requests to the MSC for processing, or the SCP can recognise that a particular request originated from an HLR and send that request directly to the MSC. We prefer to place the first two PICs of the termination call model on the HLR as the functions contained in these PICs are most closely analogous to the functions performed by the HLR in the GSM system. Thus, by keeping the semantics of the PICs closely similar between the mobile system and

the PSTN we enhance the technology and service transfer between the two networks.

5 In some applications these PICs of the termination call model may be placed on the gateway MSC (GMSC) which interacts with the HLR during MT call establishment

10 The MSC mobile call model is listed below. It will be seen that there are minor differences in the first two PICs in comparison with those associated with the HLR. These differences reflect the difference in functionality between the MSC and the HLR.

PIC #11 - T-Null

15 Initial Address Message (IAM)/Setup message is received by the terminating ISSP.

Send Info For Incoming Call message is now divided into two messages:

- 20 1) Provide Subscriber Info-- for getting subscriber (SS+IN) info, and
2) Process Term SS-- to tell VLR to process terminating SS.

Provide Subscriber Info is sent by the MSC to the VLR. The VLR acknowledges the query by sending SS and IN data.

25 e20 - Term_Attempt is unused at the terminating MSC (see HLR PIC activity).

PIC #12 - Authorize-Termination

30 The MSC sends Process Term SS message to the VLR to stimulate terminating SS processing.

The VLR responds to the Process Term SS with either a Page message or a Connect_to_Following_Addr(<newDN>). The Connect_to_Following_Addr message will only be sent if mobile terminator has subscribed-to Call Forwarding Not Registered (CFNreg.) and has detached his-her IMSI.

After the Page message the VLR sends a Complete Call message.

e21 - Call Presented is used for normal call completion (reception of Complete Call message).

5 **e28** - Cleared is used if the originator releases the call at this PIC.

e29(b)- Term_Denied is unused in the terminating ISSP (see HLR call model).

PIC #13 - Select-Facility

- 10 In certain cases the ISSP may, without paging, discover the busy or "not responsive" nature of the terminator. Under such circumstances the VLR will look into the subscriber profile of the terminator to see if any further terminating SS are applicable. If Call Waiting (CW) is applicable, a Process_Call_Waiting message is returned. For Call Forwarding No
15 Reply SS a Connect_to_Following_Addr (<newDN>) message is returned.

In general, the nature of this PIC is to realize the busy/idle status of the terminator.

- 20 **e22** - Term_Resource_Available is used if the page response is positive.

e28 - Cleared is used if the originator releases the call at this PIC.

e30 - T_Busy is used if the page processing indicates a busy subscriber.

- 25 It will be understood that the technique described above is not limited to the particular AIN 0.x call model described by way of example. Other IN call models can of course be employed. A preferred method of adapting an alternative call model to the technique is to provide a mapping between that call model and the AIN 0.x call model described in the
30 specific embodiment. An example of a mapping between a standard call model referred to as CS-1 and the AIN 0.x call model is depicted in figures 5 and 6 which show respectively the mapping of the originating call models and the terminating call models between these two protocols. By providing this mapping, the operation of the mobile

network is substantially independent of particular protocols of the intelligent network providing services to the mobile subscribers.

- 5 It will further be understood that although the above description refers to the GSM mobile system, it is not limited to that particular system but is also applicable to other standard mobile systems, such as those defined e.g. by the DCS1800 and PCS1900 Standards.

CLAIMS:

1. An arrangement for setting up an intelligent network call from an
5 intelligent network to a mobile network subscriber served via a mobile
switching centre, the mobile network incorporating a home location
register for storing information including location information relating to
mobile subscribers, wherein the call set up procedure comprises an
10 origination call model and a termination call model associated
respectively with an originating terminal and a terminating terminal
wherein the termination call model has initial stages defining routing
information requests and authorisation of termination, wherein said initial
stages are provided both in the home location register and in the mobile
switching centre, and wherein the termination call model associated with
15 intelligent network calls to mobile subscribers is shared between the
home location register and the mobile switching centre whereby to
facilitate participation of both the home location register and the mobile
switching centre in the call termination procedure.
- 20 2. An arrangement as claimed in claim 1, wherein the home location
register is adapted to provide roamer service screening of calls to and
from the mobile subscribers so as to restrict the range of services
available to a said subscriber.
- 25 3. An arrangement as claimed in claim 1 or 2, wherein a visitors
location register providing storage means for data relating to mobile
terminals within the service area of the mobile switching centre is
associated with that mobile switching centre.
- 30 4. An arrangement as claimed in claim 3, wherein the visitors
location register and the mobile switching centre together provide a
special services point for the mobile terminals.
5. An arrangement as claimed in any one of claims 1 to 4, wherein
35 said mobile switching centre comprises a gateway mobile switching

centre providing an interface between the intelligent network and the fixed network.

- 5 6. An arrangement as claimed in any one of claims 1 to 5, wherein the mobile network incorporates means for providing a mapping between a first call model employed by the mobile network and a second call model employed by the intelligent network.
- 10 7. An arrangement for setting up an intelligent network call from an intelligent network to a mobile network subscriber substantially as described herein with reference to and as shown in the accompanying drawings.
- 15 8. A method of setting up an intelligent network call from a fixed network to a mobile subscriber served via a mobile switching centre in a mobile network incorporating a home location register for storing information including location information relating to mobile subscribers, the method including defining respective origination and termination intelligent network call models, providing the termination call model in
20 the mobile switching centre, and further providing at least part of the termination call model in the home location register whereby call termination to a mobile terminal is shared between the home location register and the mobile switching centre.
- 25 9. A method as claimed in claim 8, wherein a mapping is provided between a first call model employed by the mobile network and a second call model employed by the intelligent network.
- 30 10. A method as claimed in claim 8 or 9, and including roamer service screening of calls to and from the mobile subscribers so as to restrict the range of services available to a said subscriber.

11. An arrangement for setting up an intelligent network call from an intelligent network to a mobile network subscriber substantially as described herein with reference to and as shown in the accompanying drawings.



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Claims searched: 1 to 11

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Date of search: 19 June 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L LDSC, LDSK, LDSL, LDSM, LDSX

Int Cl (Ed.6): H04M 3/42

H04Q 3/00, 7/24, 7/38

Other: On-Line: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	WO 95/26114 A1 (Ericsson) Page 6 line 37-page 7 line 8, page 15 line 10-28	
A	WO 95/21509 A1 (Ericsson) Page 5 line 22-page 6 line 30, figure 2	
A	British Telecommunications Engineering, Vol.13, Jan.1995, Alastair Brydon, "Global System for Mobile Communications", pages 287-295, especially page 288 column 3 lines 19-27	

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

& Member of the same patent family

A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.

E Patent document published on or after, but with priority date earlier than, the filing date of this application.